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Role of R&D in the productivity growth of Korean industries: Technology gap and business cycle☆

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ABSTRACT

The gap between the productivity of the Korean economy and that of advanced economies has narrowed considerably in the manufacturing sector while remaining large in the service sector. Using a panel of Korean industries, this paper assesses the determinants of Korea's productivity growth. Our empirical analysis finds that (i) labor productivity has converged across industries, (ii) research and development (R&D) investment has played an important role in fostering productivity growth, and (iii) the productivity impact of R&D is stronger in more advanced industries (i.e., industries that are close to the technology frontier) and during economic downturns. The implication is that for more developed economies, such as Korea's, in which innovation plays a key role in productivity growth, R&D spending is best focused on more advanced industries and timed counter to the business cycle.

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1. Introduction

The speed of economic growth varies according to countries' development stages. Developed countries are limited in economic growth by increasing input factors (e.g., labor and capital) and are able to grow mainly due to a growth in productivity, while countries in the early stages of development grow fast by increasing input factors (Aghion & Howitt, 2009).

Considering the development stage of the country, the economic growth of Korea has been regarded as a miracle (Lucas, 1993). It has grown fast compared to the Philippines that were in a similar economic development stage in 1960. In the 2000s, however, economic growth has significantly slowed down in Korea. This paper attempts to identify the factors that have a played role in the rapid economic growth in Korea until the 1990s and the slowdown of growth since.

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Table 1
Decomposition of GDP growth in Korea.

(Average annual growth, %)			
	1990–2001 (A)	2002–2010 (B)	B–A (%p)
GDP	6.3	4.1	−2.2
Labor productivity	5.4	4.5	−0.9
Hours worked	−0.7	−1.5	−0.8
Employment rate	0.4	0.4	0.0
Working-age population	1.3	0.7	−0.6

Source: Author's calculation using OECD statistics.

Using a simple growth accounting method, real gross domestic product (GDP) growth in a country can be affected by the growth of labor productivity, working hours per employee, employment rate, and working-age population (e.g., Gordon, 2010; Musso & Westermann, 2005).[1] Table 1 shows the decomposition of GDP growth of Korea in the 1990s and in the 2000s. Decomposition implies that (i) the labor productivity growth played a crucial role in driving economic growth both in the 1990s and 2000s, and (ii) the combined slowdown in the growth of labor productivity, working hours, and working-age population led GDP growth to tumble in the 2000s.[2]

This paper analyzes the existence of productivity convergence using a panel of Korean industries. Convergence of productivity is still controversial among economists. Following Bernard and Jones (1996), it is widely found that labor productivity has not been converging among OECD countries.[3] On the other hand, using a panel of 19 OECD countries from 1870 to 2006, Madsen and Timol (2011) find a strong evidence of productivity convergence in the manufacturing sector across countries.

The present paper contributes to the literature on convergence by exploring productivity convergence across industries in a specific country, unlike the existing literature that examines productivity convergence across countries. This paper studies whether productivity grows faster in lower productivity industries, and it finds supporting evidence on productivity convergence across industries. This result implies that the technology spillover across industries and countries can play an important role in fostering productivity growth in industries and countries where technology falls behind from the frontier.

Earlier studies have considered research and development (R&D) investment, trade openness, and human capital as important factors in determining productivity growth (Barro & Sala-i-Martin, 1992; Bernard & Jones, 1996; Mankiw, Romer, & Weil, 1992). More recent studies consider the role of the technology gap (i.e., distance to the technology frontier) to explain the productivity growth resulting from technology adoption (Cameron, Proudman, & Redding, 2005; Griffith et al., 2004; Madsen & Timol, 2011). Empirical findings from previous studies show that productivity grows faster in countries where (i) R&D intensity is higher, (ii) the productivity gap from the technology frontier is larger, (iii) trade openness is higher, and (iv) the skill of human capital is higher.

Acemoglu, Aghion, and Zilibotti (2006) and Benhabib, Perla, and Tonetti (2013) emphasize that R&D investment promotes the productivity growth by facilitating innovation and imitation. Acemoglu et al. (2006) introduce a model where technology adoption plays a crucial role in productivity growth when distance to the frontier is large, while innovation becomes important when that distance closes. Similarly, Benhabib et al. (2013) propose a model that productivity grows as a result of investment in innovation and in imitation, where imitation facilitates technology adoption, and it increases with distance to the frontier. In addition, several recent papers differentiate between technology spillover from global frontier firms to national frontier firms and those from national frontier firms to non-frontier firms (e.g., Andrews, Criscuolo, & Gal, 2015; Bartelsman, Haskel, & Martin, 2008).

This paper also explores the relationship between R&D investment and the business cycle. The literature identifies two important effects of business cycles on R&D activities: (i) the cash flow effect (Hall, 2002; Himmelberg & Petersen, 1994) and (ii) the opportunity cost effect (Gali & Hammour, 1992; Nickell, Nicolitsas, & Patterson, 2001; Saint-Paul, 1993). The opportunity cost effect plays a role in fostering R&D and productivity growth during recessions, while the cash flow effect reduces R&D during recessions. Therefore, the relative importance of these two effects may influence R&D activities and the cyclicality of productivity growth. Departing from existing literature, the present paper investigates whether the productivity growth effect of R&D differs across business cycles. This paper specifically tests whether the growth-enhancing

[1] Decomposition is derived from the identity, $Y \equiv \frac{Y}{H} \times \frac{H}{E} \times \frac{E}{L} \times L$, where Y, H, E, and L denote real GDP, total hours worked, number of employees, and working-age population (aged 15–64), respectively.

[2] The classification of periods corresponds to the business cycles of the Korean economy, i.e., the periods 1990–2001 and 2002–2010 roughly coincide with 5–7 and 8–10 business cycles, respectively.

[3] The literature examines two types of productivity convergence: (i) β-convergence refers to the negative correlation between the productivity growth and initial productivity levels (speed), and (ii) σ-convergence refers to the decrease in standard deviation of productivity (volatility) (e.g., Barro & Sala-i-Martin, 1992; Griffith, Redding, & Van Reenen, 2004; Madsen & Timol, 2011). Note that this paper focuses on β-convergence of productivity across Korean industries.

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